U.S. DEPARTMENT OF EDUCATION

Enterprise Information Technology Architecture

The Architecture Framework

Volume I

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PREFACE

A sound Information Technology Capital Planning and Investment Management Process requires a comprehensive Information Technology Architecture (ITA) to guide decision makers in the selection of information technology investments. This document, the Information Technology Architecture Framework, provides the high-level view that lays the groundwork for developing an enterprise-wide ITA for the Department of Education.

The ITA Framework is based on the Department of Education (ED) Strategic Plan, which sets forth the business goals and objectives of the Department. These business drivers support a vision for ED information technology. A set of architecture principles, or clear statements of how ED plans to use information technology in the long-term, results from the information requirements implicit in the business drivers derived from the Department's Strategic Plan .

The architecture principles are the core of the ITA Framework. They will guide the development of the target architecture throughout the ITA development process. Each ITA principle has a rationale. Each one also has implications with potential benefits and advantages as well as implications with potential costs and risks for the Department. The potential costs and risks are, for the most part, not deterrents, but rather part of the investment costs of moving from an undisciplined IT management approach to one that is structured, built on sound business principles, and disciplined. In theory, and in practice, the long term benefits should far exceed the costs of converting to the disciplined ITA approach.

Perhaps most important, a disciplined ITA will support a sound technical plan for reinventing the Department's work processes and ways of doing business. In this context, the ITA Framework is the first document of the long-range IT plan that will help reorganize the Department's operations around its customers. Technology will be used to manage and simplify routine processes, thereby freeing staff to become customer-service specialists who will provide a wide range of customized services to ED partners and customers. The result will be the transformation of ED from an agency that primarily processes grants and contracts to a flexible organization designed to meet the complex and changing information needs of the education community.

Finally, the IT Architecture Framework is first phase of a seven-phase process aimed at institutionalizing the development and renewal of an information technology architecture at the Department of Education. The final section of this document, which lays out next steps, describes the remaining phases toward a matured IT architecture process.

Introduction

Background

In 1993, the Vice President's National Performance Review (NPR) sought to create "a government that works better and costs less" by reducing staff, eliminating unnecessary programs, cutting obsolete regulations, and encouraging innovations to improve customer service and save taxpayer dollars. Later that same year Congress passed the Government Performance and Results Act, which required Federal agencies to develop long-range strategic plans, establish annual performance plans linking agency budget requests to the goals and objectives of their strategic plans, and report annually to Congress on progress toward those goals and objectives.

In 1996, Congress passed the Information Technology Management Reform Act, also known as the Clinger-Cohen Act, which recognized the strong and growing relationship between government reinvention efforts and the effective management of agency information technology resources. The Clinger-Cohen Act required a Chief Information Officer (CIO) in each Federal agency to ensure that information technology investments are aligned with strategic plan goals and objectives. Agency CIOs also are responsible for ensuring that work processes are reinvented and simplified prior to designing and investing in supporting information technology. The primary vehicle for fulfilling these responsibilities is a sound and integrated information technology architecture, which the Clinger-Cohen Act defines as a "framework for evolving or maintaining existing information technology and acquiring new information technology to achieve the agency's strategic goals and information resources management goals."

Strategic Planning at the Department of Education

The Department of Education (ED) launched a comprehensive strategic planning effort soon after the passage of the Government Performance and Results Act. In fact, Department efforts had begun even earlier with a consensus-based process that established an agency mission statement:

> *To ensure equal access to education and to promote educational excellence throughout the Nation.*

The first Strategic Plan working document was completed in December 1994. This document was widely distributed, both internally to Department managers and staff and externally to Congress, stakeholder groups, educators, and others interested in the Department's operations and goals.

The first Strategic Plan also was used to stimulate a wide range of reforms and improvements in Department operations. Examples include the termination of 64 unnecessary programs for a savings of over $700 million in annual appropriations, the elimination of two-thirds of the regulations covering elementary and secondary education, and slashing the student loan default rate by more than one-half while doubling collections on defaulted loans.

In 1997, the Department updated and revised its Strategic Plan to incorporate recent accomplishments, changing priorities, and input from outside reviewers such as the General Accounting Office and Congress. This revision, which was submitted to Congress in September 1997, reflected the Department's commitment to make its Strategic Plan a living document that will be as useful as possible both as a guide to long-term goals and a gauge of success in reaching those goals.

And to align all resources and improvement strategies with the Strategic Plan goals, the Department prepared its first Annual Performance Plan, which was submitted to Congress in February 1998. This Annual Performance Plan provides a set of benchmarks that permit Congress and the public to judge whether the Department's programs are working effectively to help states, communities, families, and individuals to reach their educational goals.

The Role of Information Technology in the Department

Information technology is critical to reaching the Department's strategic goals and objectives. Nearly every ED program and activity already relies on technology to disseminate information and collect data, and the Department increasingly is using technology to streamline and improve basic processes like applying for discretionary grants or determining eligibility for postsecondary student aid. In fact, it is safe to say that ED will call on information technology in some form to help accomplish every single objective in its Strategic Plan. This will particularly be the case in view of the continuing emphasis on balanced budgets and reducing the size of government. Effective use of technology is one key to coping with increasing workload at a time of tight or declining administrative budgets and smaller staffs. It was this combination of the ubiquity and importance of information technology that led Congress to pass the Clinger-Cohen Act.

Strategic planning naturally encompasses information technology, but the Clinger-Cohen Act makes the link explicit and assigns responsibility for establishing and maintaining that link to the Chief Information Officer. The central message of the Clinger-Cohen Act is that information technology must be designed, purchased, and implemented so as to optimize agency performance in pursuit of its strategic goals.

The Clinger-Cohen Act recognizes that there are risks associated with information technology, risks that grow with the complexity of that technology and with our reliance on it. Projects may not be completed on time, may cost far more than initially projected, or may produce unreliable systems. The rapid pace of technological change may render "new" systems obsolete before they are completed. The existence of multiple communications protocols may result in systems that

are unable to "talk" to each other. Program managers making information technology investments to help accomplish strategic goals need a structured process for moderating these risks.

A sound information technology architecture (ITA) both aligns information technology resources with the Department Strategic Plan and reduces the inherent risks of investing in products and systems based on complex and rapidly changing technologies.

Developing an ED Information Technology Architecture

The Department of Education launched a formal effort to develop an enterprise-wide information technology architecture in late 1997, following the completion of the intensive GPRA-related strategic planning processes, which produced the Department's revised Strategic Plan and first-ever Annual Performance Plan. The development of the ITA is an essential part of implementing these plans.

An information technology architecture provides the principles, recommended practices, standards, and products needed to guide IT professionals in the development and implementation of a technology infrastructure that supports the business functions of an enterprise. A sound ITA is also the common ground where business managers and IT managers can reach the consensus required to continuously align information technology solutions with business needs.

ED's Chief Information Officer established an ITA Working Group composed of senior information technology professionals representing major agency information systems. The Working Group benefited significantly from the substantial progress already made in several areas of ED information technology. For example, the Program Systems Service in the Office of Student Financial Assistance Programs had nearly completed its own architecture framework document, which provided a model for the Working Group. In addition, the Chief Information Officer, who also serves as the Department's Chief Financial Officer, was implementing a new agency-wide financial management and accounting system (the Education Central Automated Processing System, or EDCAPS), which had been developed in conformance with many of the principles specified in the Clinger-Cohen Act. And the Department's network services group, which operates EDNET, had made rapid progress in creating reliable local and wide area networks connecting all Department employees and in establishing a strong, award-winning Department presence on the World Wide Web.

The Technical Architecture Framework for Information Management Model

The ITA Working Group agreed to follow a modified version of the Technical Architecture Framework for Information Management (TAFIM), a multi-volume ITA "how-to" manual developed at the Department of Defense, in creating an information technology architecture for

the Department of Education. The Architecture Framework Document is the first of a series of planning documents generated by the TAFIM process that is aimed at moving an organization step-by-step toward a sound information technology architecture.

The ED Architecture Framework Document begins with an assessment of business drivers that suggest a long-term vision of ED information technology. The resulting information requirements help generate a set of architectural principles that provide the conceptual foundation for the ITA.

Business Drivers

Agency Funding and Functions

Approximately 4,600 full-time equivalent staff administered 197 programs at the Department of Education in fiscal year 1997. The Department depends on annual Congressional appropriations to fund its programs and activities. The $33.5 billion appropriation in fiscal year 1997 supported about $68 billion in aid to education, including about $33 billion in grants to state and local educational agencies, postsecondary institutions, and individuals and about $35 billion in new loans to postsecondary students from the Department or private lenders. Federal administrative costs in fiscal year 1997 were about $800 million, or 1.2 percent of the $68 billion in total aid. The Department also administers a portfolio of outstanding student loans that totaled $131 billion in fiscal year 1997.

The Department's mission is to ensure equal access to education and to promote educational excellence throughout the Nation. The Department carries out its mission by working in partnership with states, schools, communities, institutions of higher education, and financial institutions.

Key agency functions include:

- Providing national leadership on critical issues in American education
- Making grants to education agencies and institutions to strengthen teaching and learning and prepare students for citizenship, employment in a changing economy, and lifelong learning.
- Providing student loans and grants to help pay the costs of postsecondary education.
- Providing grants for literacy, employment, and self-sufficiency training for adults.
- Monitoring and enforcing civil rights to ensure nondiscrimination by recipients of Federal education funds.
- Supporting research, statistics, assessment, and dissemination activities to improve educational quality and effectiveness.

External Factors

The Department of Education's funding and functions are affected by several external factors:

- Importance of Education for the Economy. Growing numbers of Americans see education as essential to prosperity and competitiveness in the global economy. Modern, technology-based jobs demand increasingly high levels of educational preparation and skills, leading to demands for higher academic standards at the elementary and secondary school levels as well as greater opportunities for postsecondary vocational training.

- State and Local Control of Education. States and communities are responsible for key decisions such as implementing challenging standards and making the long-term investments needed to improve educational achievement, including investments in information technology.

- Parental Involvement. Department efforts to improve the quality of education depend in part on success in increasing the involvement of parents in their children's education and schools. Research shows that parents and families play the most critical role in individual educational success.

- Congressional Authorization and Appropriations Processes. Congress provides the ground rules and resources for carrying out Department programs and activities through the authorization and appropriations processes. The Department has benefited from significant budget increases in recent years, thanks in large part to President Clinton's determination to make education a national priority, but there is no guarantee that this trend will continue. Moreover, increased funding for education programs is not always accompanied by increases for program administration funding, which supports investments in information technology. Program administration funds also are often the target of cuts during the Congressional appropriations process.

- Government-Wide Management Reforms. In addition to agency-specific legislation, there are a number of government-wide statutes that affect Department operations and information requirements, including the Government Performance and Results Act, the Paperwork Reduction Act, the Chief Financial Officers' Act, and the Clinger-Cohen Act. Many of the administrative requirements included in these and other laws are implemented primarily through regulations issued by the Office of Management and Budget.

- The Internet. The tremendous growth in access to and use of public data networks like the Internet hold great promise both for improving Department operations and for revolutionizing teaching and learning. These networks are creating new and unprecedented opportunities for getting useful education information in the hands of students, parents, teachers, and education policy makers.

- National Economic Performance. Economic downturns may reduce the state and local tax revenues that finance 95 percent of elementary and secondary education, decreasing the

resources available for classroom instruction. Periods of high unemployment also may lead to higher rates of default on postsecondary student loans.

- Social Ills and Stresses. Many Department programs and activities are intended to compensate in part for social factors such as poverty, crime, child abuse, and drug and alcohol use that have a strong negative impact on educational success.

Internal Factors

A variety of internal factors also affect ED operations:

- New Initiatives. In response to the growing prominence of education as a national priority, the Department has developed and implemented major new initiatives in recent years, such as the Direct Loan program, the Goals 2000: Educate America Act, the School-to-Work Opportunities Act. the Improving America's Schools Act, and the Educational Research, Development, Dissemination, and Improvement Act. In general, these new activities are significantly larger and more complex administratively than the programs that have been terminated during the same period.

- Reinvention of Work Processes. ED also is engaged in a continuous process of reinventing and streamlining its operations, both in response to problems identified by outside observers such as Congress and the General Accounting Office and as part of the management reform efforts launched by the National Performance Review and the Government Performance and Results Act. Management improvements include reduction of supervisory layers and the creation of cross-cutting teams.

- Performance Based Organization. Another significant change is the pending transformation of the Office of Student Financial Assistance Programs into a performance-based organization (PBO). This change would provide the student aid programs with the independence and autonomy needed to create a more flexible, entrepreneurial approach to improving the delivery of student financial aid. The PBO would remain part of ED, with a Chief Operating Officer reporting directly to the Secretary.

- Declining Administrative Resources. The Department has undertaken significant new administrative responsibilities in recent years while downsizing its staff as part of President Clinton's effort to reduce the size of the Federal government and while receiving only modest increases in administrative funding. This tension between a growing workload and declining or static administrative resources is expected to continue as ED is proposing several new education reform initiatives for fiscal year 1999.

Strategic Plan Goals

The Department's core work processes involve designing, awarding, and monitoring grants, contracts, and student loans aimed at improving the equity, quality, and performance of America's education system at all levels. The Strategic Plan is designed to maximize the impact of this financial support by setting performance goals that permit taxpayers to hold the Department accountable for results. ED's five-year Strategic Plan established four major goals designed to help achieve the mission of ensuring equal access to education and promoting educational excellence throughout the Nation:

Goal 1. *Help all students reach challenging academic standards so that they are prepared for responsible citizenship, further learning, and productive employment.*

Goal 2. *Build a solid foundation for learning for all children.*

Goal 3. *Ensure access to postsecondary education and lifelong learning.*

Goal 4. *Make ED a high-performance organization by focusing on results, service quality, and customer satisfaction.*

For each goal, the Strategic Plan identifies several objectives, along with core strategies and performance indicators for reaching the objectives. Key objectives and strategies with information technology implications include the following:

<u>Access to Education Information</u>

1. Provide fast, seamless service and dissemination of information and products.

2. One-stop shopping for customers seeking publications, regardless of source within ED.

3. Develop and implement a comprehensive dissemination system of effective practices that increases the education community's access to and use of research-based products and services.

4. Support full access for customers with disabilities.

5. Develop customer feedback mechanisms and equip staff with information technology required to meet customer requests.

<u>Postsecondary Student Financial Aid</u>

6. Create a student, prospective student, and family-focused system to support postsecondary education.

7. Provide the customer a single point of interface for Federal student aid programs and potentially within the larger postsecondary education community.

8. Streamline, simplify, and improve the accessibility of processes and data associated with postsecondary education.

9. Reduce costs and improve program integrity and oversight associated with the management and delivery of postsecondary education services.

10. Support lifelong learning at multiple schools.

Information Technology

11. Create a cost effective, efficient, accessible, and reliable network infrastructure, with modern workplace software and hardware, to promote productivity and meet business needs.

12. Provide robust, reliable, and secure Internet service that effectively presents and distributes educational information and processes business transactions for internal and external customers.

13. Develop a Department-wide information collection and dissemination system using a data warehouse to provide easy access to ED data and eliminate data duplication.

Financial Integrity

14. Provide timely and reliable information to program offices through the Education Central Automated Processing System.

15. Obtain a clean audit opinion of annual ED financial statements.

16. Provide training and incentives for both financial and program staff to acquire core financial management competencies.

The ED IT Vision

Back to the Future

The original Department of Education was created in 1867 to collect information on schools and teaching that would help the States establish effective school systems. Over 130 years later, modern information technology promises to take the Department back to its roots by transforming the agency into an effective, customer-driven information resource for nationwide educational change and improvement.

- A Logical Next Step: The technology-based, customer-focused phase of management reform follows naturally from the evolution of the Department of Education (ED) under the leadership of President Clinton and Secretary Riley. The wide range of legislative and management improvements implemented by the Department over the past five years share a common thread: a desire to better meet the needs of the Department's many customers. This is what drove the Goals 2000: Educate America Act, which responded to State and local demands for flexible Federal support to help them meet high academic standards; the Direct Loan program, which offered postsecondary students and schools a simplified student loan program at lower cost to students and taxpayers; the elimination of two-thirds of the regulations governing programs authorized by the Elementary and Secondary Education Act; the approval of hundreds of waivers of other statutory and regulatory provisions that stood in the way of effective reforms, as well as the ED-FLEX initiative that allows State officials in 12 States to waive Federal rules and regulations; the significant reduction of paperwork and reporting requirements for recipients of Federal education funds; a more cooperative and collaborative approach to the resolution of audit disputes with States and school districts; and the development of strategic and annual performance plans designed to help measure the return on the Federal investment in education.

- Putting Customer Needs First. These are just a few examples of how ED has changed the way it does business in response to customer demands for more flexible, helpful, responsive, and accountable Federal support for educational improvement. The implications are clear and dramatic: instead of telling our customers what to do, we now are asking them how we can help. This new approach reflects the reinvention principles established by President Clinton and Vice President Gore through the National Partnership for Reinventing Government: putting customers first, cutting red tape, empowering employees to get results, and getting back to basics. The enabling technology for putting these principles into practice at the Department of Education is the PC-based, networked world.

The Networked World

The rapid expansion of the Internet and other public data networks, coupled with the widespread adoption of PC-based client-server computing platforms, is creating unprecedented opportunities for direct, real-time contact with ED customers and rapid, cost-effective response to their needs. The Department has long used technology to streamline and improve existing processes, but growing computing power and expanding networks make possible entirely new ways of accomplishing basic tasks, while encouraging a restructuring of the Department to support more effective interactions with its many customers.

- Automate the Routine. Routine business functions like application processing, payments, accounting, data collection, and filing will become increasingly simplified, automated, and routinized.

- Customer Service Teams. With fewer and fewer staff engaged in such "back office" activities, the Department will be able to devote substantially more resources to front-line customer service. Highly trained customer service teams would be organized around specific constituencies, such as parents, teachers, postsecondary students, or student aid officers. These teams would be supported by Department-based experts as well as traditional program staff. The information and services available would be driven by customer needs, not by Washington politicians and bureaucrats. And in a networked world, ED customer service staff would be able to access expertise and resources outside the Department, tapping into university-based research, for example, or informing customers of the availability of foundation grants for particular reform efforts.

- Changing the ED Culture. A key long-term challenge will be to change the culture of the Department and its staff. Top-down, hierarchical structures and attitudes based on rigid adherence to time-consuming bureaucratic rules and procedures and demanding customer compliance with those rules will give way to bottom-up, flexible, team-based approaches to identifying and meeting customer needs in real time through creative use of modern PC-based network technologies. These changes will require extensive professional development for ED staff in the areas of technology, teamwork, and customer service skills.

- Electronic Information Service. At the heart of this new approach will be a comprehensive, Internet-based electronic information service serving both Department staff and its many partners and customers. This service will integrate existing web sites, organizations, and human expertise along with new services and technologies into a cohesive system designed for rapid location of information and answers to customer questions and requests. There also will be a strong emphasis on monitoring and responding to customer needs and enabling citizen participation in electronic discussions and communities of interest. Although ED and ED-funded institutions will form the core of the system, it will be designed from the start to involve other federal, state, and local government organizations, associations, information centers, clearinghouses, technical assistance providers, businesses, and volunteer organizations to provide customers a true "one-stop, any-stop" information utility.

- Direct Access to Information. Customers who choose to access information themselves (self-service) will use an intuitive, natural language interface to quickly and efficiently find relevant, useful information. The electronic information service will permit customers to enter the system at any point and immediately have access to the entire collected knowledge base of hundreds of participating organizations. This knowledge base will contain a wide array of education-related resources, including research and best practices, data about the characteristics and performance of our education system at all levels, information on Department programs and other funding opportunities, teaching and learning materials, and pointers to discussion forums allowing customers to tap into a broad range of experience and expertise.

- The Human Touch. Customers who prefer a human touch will contact service representatives at any of ED's customer service centers, clearinghouses, technical assistance providers, or partner services, each of whom will be able to field questions on any topic because they will have access to a robust electronic infrastructure for question answering and referrals.

- Expanding the Knowledge Base. As the hundreds of participating organizations respond to customer inquiries, the questions and answers will be collected in a distributed knowledge base which will support answer reuse, trend and gap analysis, generation of frequently asked questions (FAQs), and choice of topics for publications and research. This will help ensure that back-office research and development efforts fully reflect the needs identified through front-line contact with ED customers.

- Continuous Citizen Participation. The system will also greatly expand opportunities for parents, teachers, superintendents, school board officials, researchers, and anyone with an interest in education issues to "talk" to each other regardless of geographic location. ED will sponsor ongoing online discussion forums on major priorities and initiatives. These forums will promote active discussion of important issues, provide a powerful means of obtaining public comment on ideas and proposals, and encourage the creation of communities of interest which can serve as standing bodies of experts on a topic.

Customized Customer Services

A significant benefit of this new electronic information system will be the opportunity for customized services. In a networked world, the one-size-fits-all solution is simply obsolete. It will be possible through electronic communications to tailor information and/or solutions to individual schools, classrooms, or even students. Here are a few examples of the services that might be provided to selected customers.

Future Vision 1. A Family Moving to a New Community

The Miller family is moving from their current home in Virginia to Springfield, Illinois before the start of school in September. The oldest Miller child will be entering high school and two

others will be in elementary school. Mrs. Miller wants information on the schools in Springfield before she and her husband decide where to buy a home. She remembers President Clinton talking about a new system that would provide information about every school in the Nation, and she visits the Department of Education's home page to see what she can find. A hot button at the ED site takes Mrs. Miller to the National Education Information System, where she finds data on every school in Springfield, including school demographics, academic offerings, graduation rates, and recent results on standardized tests. She also discovers links to individual school home pages. After about an hour on the Internet, Mrs. Miller has the name and phone number of the principals at a half dozen schools she and her husband will check out when they visit Springfield to look for a home.

Future Vision 2. Teachers Seeking Resources for an Innovative Program

A group of teachers at an inner-city grade school in California develop an idea for improving mathematics instruction for minority females in the 4th and 5th grades. They log on to the ED web site and access the National Inventory of Education Programs, a database of education programs throughout the Nation and the world. The teachers search for programs benefiting minority female elementary school students in which program outcomes include improved math skills. They also discover an online discussion forum on mathematics instruction that leads to contacts with other schools and teachers working to female minority mathematics achievement. The group of teachers put together a list of promising programs and practices in a presentation to their school principal, who authorizes planning time during the school day so that the group can more fully develop its proposal and submit an application for funding.

Future Vision 3. A Congressman Working to Streamline Federal Support for Education

Congressman Smith is a strong supporter of the Federal role in education, but he believes that the large number of education programs administered by various Federal agencies create confusion for grant applicants and result in the expense of administrative funds that might otherwise be available to make additional grants. The Congressman uses the National Inventory of Education Programs to identify programs with similar beneficiaries, the same educational partners, and that target similar educational outcomes. This information helps him develop a legislative proposal that would consolidate similar programs from five agencies, streamline program administration, and save administrative costs without reducing the level of benefits for program recipients.

Future Vision 4. A High School Student Seeking an Affordable College Education

John is a high school junior who is seeking a top-quality but affordable postsecondary education. As part of his search, he logs on to the EASI (Easy Access for Students and Institutions) web set maintained by the U.S. Department of Education. John thinks he would like to attend a small school near his home in Columbus, Ohio, and his favorite subjects in high school are English and Physics. He types in his request using the natural language-based *EASISearch* and learns that there are nine schools in the midwest with enrollments under 2,000 offering majors in both English and Physics. He also learns that six of the schools graduate more than 90 percent of their students who enroll as freshmen. John works as an English tutor for elementary school students, and he was pleased to see that five of the schools on the EASI list place a strong emphasis on community service. John asks EASI to send him additional information, including financial aid opportunities, on the four schools that boast both a high graduation rate and an active role in their communities, and he also takes note of the links to the school web sites provided by EASI.

The information on John's four potential college choices arrives the following week, and after reviewing the materials—and paying a visit to the two schools located nearby in Ohio—he decides to apply to three of the schools, as well as to State University, a low-cost "safety school" option that would allow him to live at home while attending school. John logs on to EASI once again and completes a single, computer-based application that meets the admissions requirements of each of his choices. John also uses EASI to apply for financial aid, completing a single computerized application that covers Federal, State, and institutional sources of postsecondary student financial assistance.

Three weeks later John learns not only that he got into his two top schools—Greenbriar College and Simonton University—but also that he qualifies for a combination of Federal and institutional aid that will bring the cost of attending Greenbriar down nearly to the same level as if he lived at home and attended State U. John talks over his options with his parents and his guidance counselor before logging on to EASI one more time. He enrolls at Greenbriar through EASI, which also disburses student aid funds on John's behalf to cover his first semester expenses at the school.

Implementing the Vision

The Department has already made considerable progress in modernizing and upgrading its information technology systems to support this vision. These efforts have focused on three major areas: Internet Services; the Education Central Automated Processing System (EDCAPS), and Project EASI.

- Internet Services. The Department has established an award-winning presence on the World Wide Web at www.ed.gov, which also serves as a gateway to nearly 200 other ED-funded web sites. In April 1998, a *New York Times* survey found that the ED web site was the most

popular site on the Internet for K-12 teachers, and that the ED-funded Education Resources Information Center (ERIC) operated the second most popular site. Department web pages are viewed about 5 million times a month.

— All ED publications are now available electronically. *The Guide to ED Programs*, for example, is continuously updated to reflect the latest program information and Congressional action. The former hardcopy version was almost always out-of-date at the time of publication.

— ED has also spearheaded the development of the Federal Resources for Educational Excellence (FREE) site, which in cooperation with 34 other Federal agencies provides hundreds of resources to improve teaching and learning. Shortly after its launch in April 1998, a survey found that FREE was the most popular K-12 offering on the ED web site on the Internet for teachers.

— Other popular links at www.ed.gov include the *Student Guide to Financial Aid* and *FAFSA On the Web*, the electronic version of the Free Application for Federal Student Aid.

- Education Central Automated Processing System (EDCAPS). The implementation of EDCAPS in fiscal year 1998 is a key step toward automation of common Department business processes. EDCAPS is an integrated financial management system that uses shared databases throughout the Department to improve customer service for program recipients, lower administrative costs, cut paperwork and reporting requirements, and support the preparation of auditable financial statements. For example, EDCAPS permits grant recipients to access current information on their awards online and draw down funds via the Internet. EDCAPS is replacing six legacy systems with an integrated system based on client-server technology, COTS products, interactive application software, web-enabled applications for direct customer access and service, and shared data repositories.

- Project EASI (Easy Access for Students and Institutions). Project EASI began in 1995 as a collaborative effort by members of the postsecondary education community and the Department to define and implement a customer-focused system to support postsecondary education. Within Project EASI, the Department is working to reinvent its business processes and modernize its postsecondary systems in an effort to develop a world-class comprehensive student financial aid delivery system using state-of-the-art information technology. The Department's Office of Student Financial Assistance Programs is developing an information technology architecture that will chart a course for the replacement of 11 stovepipe legacy postsecondary systems with an integrated system that meets EASI requirements.

Architecture Principles

Definition of Architecture Principles

A comprehensive information technology architecture is essential to further implementation of the ED information technology vision. The critical first step toward creating an effective ITA is the development of architecture principles.

According to the TAFIM, architecture principles are "simple, direct statements of how an organization wants to use information technology in the long term." Architecture principles are derived primarily from business drivers, but also may be influenced by organizational practices and policies, existing architectures, strategic business decisions, and trends in information technology. These principles are expressed at a high level, and are not intended to define standards and technology choices. Rather, the principles focus on the expected behavior of the information technology architecture which, when combined with information about the baseline and target architectures, will guide IT professionals in the development of standards and selection of vendor products needed to produce that behavior.

The Department's Principles

Each principle includes a rationale for its selection as well as a brief assessment of the benefits and costs associated with its application. The migration to a standards-based IT architecture will require investments not only in technology but also in the cultural and institutional changes needed to support reinvented work processes in an IT environment based on open systems and shared resources. In particular, the Department must be careful to strike the right balance between the application of enterprise-wide IT principles and standards and the need to encourage creativity and entrepreneurial behavior in the pursuit of strategic goals and objectives.

GENERAL PRINCIPLES

Principle 1. The ED information technology architecture will be designed and periodically updated to support the Department's Strategic Plan goals, objectives, and strategies.

Rationale: In accordance with the Clinger-Cohen Act and subsequent guidance from the Office of Management and Budget, the ED ITA is intended to ensure that IT investment are aligned with agency mission and goals. An effective ITA will guide the acquisition of the technology needed to process the information the agency uses to accomplish its work.

Potential Benefits and Advantages:

1. IT investments will be directly linked to business needs.

Potential Costs and Risks:

1. Implementing the ITA may entail short-term disruption in the pursuit of long-term improvements.

Principle 2. An enterprise-wide, open systems standards-based common operating environment (COE) will be established.

Rationale: A open systems standards-based COE facilitates development of common applications, supports interoperability, and encourages resource sharing.

Potential Benefits and Advantages:

1. Setting enterprise-wide COE standards will reinforce centralized policy making while encouraging data sharing and automation of shared functions.
2. Automation of shared functions will lead to lower administrative costs for principal offices.
3. Information Technology Investment Review Board (ITIRB) will ensure enforcement of standards through implementation of the information technology investment management process.

Potential Costs and Risks:

1. Standards that are too rigid and narrow may discourage local responsibility and creativity.
2. Initial costs will be associated with changing to the COE standards .
3. Principal offices may resist loss of information management autonomy.
4. Staff will require training in standards-based acquisition and project management.

Principle 3. ED will use a structured investment management process to evaluate and approve all investments in major information systems.

Rationale: A fully matured IT investment management process will ensure that the Department's information technology investments support ED business objectives, comply with the enterprise IT architecture, focus on the total costs of ownership, and provide reasonable returns on investment.

Potential Benefits and Advantages:

1. Senior officers serving on the ITIRB will make decisions based on business assessment principles, such as financial analyses and business case presentations.
2. Senior officers will share decision-making responsibilities for major information technology projects throughout the Department.
3. IT investments will be assessed for expected return on investment, as well as on compliance with the IT Architecture.
4. Better initial decision-making will result, as well as early corrective action if a project deviates from budget, schedule, or performance plans.
5. IT investments will return higher value.

Potential Costs/Risks:

1. Extensive project management training will be required.
2. Benefits of proactive management will not be realized immediately.
3. ITIRB membership training will be required, costly for managers at very senior levels.
4. Extensive time and effort will be required initially to develop information systems that collect and report on newly required project management information.

Principle 4. ED will adopt standardized information technology management practices and products.

Rationale: Standard information technology management practices and products are not in use across the Department today making it difficult to assess status and progress of IT investments. Use of standard management practices and products by all the offices and programs will enable the Department to review the enterprise investment portfolio objectively and comparably, and to make sound planning, funding and operational decisions.

Potential Benefits and Advantages:

1. Use of standardized information technology management practices and products, ones that provide accurate status measurement against milestones, will allow managers to anticipate problems and take preventive corrective actions.
2. Standardized information technology management practices will also give the Department the capacity to view project status across the board and determine the condition of the IT Investment Portfolio.
3. Use of standardized information technology management practices and products will reduce operations and maintenance costs over the long-term.

Potential Costs and Risks:

1. Managers will have to learn and apply new management skills. The application of practices such as Earned Value Management may be difficult at first and probably will require significant training and mentoring during implementation.
2. Use of the emerging government standard IT Investment Management tool, I-TIPS, will require significant effort to initially load the data base and may initially encounter resistance from project managers. Training and orientation to the purpose of using the standard tool will be required.

Principle 5. New or replacement information systems will be implemented only after work processes have been examined for possible simplification or reinvention.

Rationale: The Clinger-Cohen Act requires that work processes be streamlined or otherwise redesigned prior to investing in information technology to support those processes. The mandate is on process improvement, not just applying new technology to old processes.

Potential Benefits and Advantages:

1. Work processes will be streamlined and cost effective.
2. Systems will no longer be developed using antiquated work processes.
3. Business and work processes will be well documented and understood.
4. Systems will be most responsive to business needs.
5. Software will be developed with tools based on business rules.

Potential Costs and Risks:

1. Increased time and resources will be invested up front to assure correct requirements analyses.
2. Change management will be required as jobs, organizations change.
3. Work process change is painful in the near term.
4. Realization of benefits is deferred.
5. Disciplined methodologies will be required to assure business process re-engineering is successful.

Principle 6. Applications and infrastructure components will be designed and implemented to facilitate monitoring and measurement.

Rationale: To assure an appropriate return on IT investments, ED must be able to measure the performance of these investments, consistent with the Government Performance and Results Act and the Clinger-Cohen Act.

Potential Benefits and Advantages:

1. Consistent business management information will result in better investment management decisions, thus better returns on investment.
2. A standard IT project management information system will provide access to comparable data and analyses for all IT projects, both for initial and ongoing IT investment decision-making.
3. Project monitoring and reporting will help business and IT managers prevent cost overruns, project delays, and system failures.
4. A standard system has been built, supported by National Performance Review funding, for use by all government agencies; the Department can acquire and implement this system for a small investment.

Potential Costs and Risks:

1. Business and IT managers will need training on what to measure and on how to collect and analyze management information regarding project budgets, schedules, and performance.
2. At all levels components will need to provide data about their operation and performance. New project monitoring systems will be required, and managers trained to use them.

Principle 7. Acquisition strategies will appropriately allocate risk and effectively use competition, and will be performance-based.

Rationale: In order for the agency itself to focus on results and meet or exceed its performance objectives, it is critical that the resources ED needs to acquire from the private sector are competitive and represent the best value, and those acquiring resources understand their role, responsibilities, and performance expectations for their contribution towards meeting those objectives.

Potential Benefits and Advantages:

1. Establishment of performance based contract requirements will cause staff to focus on outcomes which meet specific measurable objectives.

2. Scarce personnel resources can be relieved of having to direct minute, individual tasks, that in and of themselves may not have much value, by placing responsibility on the contractors to deliver agreed upon results with minimal staff intervention.
3. Best value investments will result by competitively seeking commercial solutions.
4. By holding contractors accountable for the quality of their performances, ED can reward good performances and assure the contractor bears appropriate negative consequences for bad performance.
5. Creates a basis for use of strategies to streamline the acquisition award and delivery lead time.

Potential Costs and Risks:

1. Significant lead time will be required in developing contract specifications and pricing strategies.
2. Staff will require significant additional training, beyond the introductory concepts of performance based service contracting.
3. Staff will need to be especially astute in dialogue with potential offerors and to conduct market surveys to assure the viability of commercial offering and vendor's ability to meet critical objectives, and to do this in a way that does not jeopardize the benefits of competition.
4. Contractor and project manager staff will require greater understanding of how to develop and utilize appropriate financial incentives to assure optimal performance, and of the relationship of risk management and cost.

Principle 8. To achieve open systems, accepted industry and government standards will be adopted for all ED systems, unless waived by the Secretary under extraordinary circumstances.

Rationale: Accepted industry and government standards encourage vendor-neutrality, which supports open systems, re-use of standard components, cross-functional systems, and transportability between host locations and service support providers..

Potential Benefits and Advantages:

1. Reduced use of high cost custom developed and maintained systems.
2. Increased opportunity for shared data use.
3. Reduced reliance on outdated, difficult to replace, incompatible legacy systems and achievement of open systems which can be maintained and sustained at optimal levels over long periods of time.
4. Ability to utilize current market tested commercial products and implement commercially available upgrades upon release.
5. Improved opportunities for interacting with the education community and ED business partners.

Potential Costs and Risks:

1. Conversion from unique customized legacy applications will be resource intensive.
2. Changes will be required from use of proprietary components to components using interfaces built with industry-wide standards.
3. Implementing standards-based components will require investments in new and replacement products.
4. Staff will have to learn new business practices.

Principle 9. Vendor independence will be promoted through the use of non-proprietary specifications and interchangeable components.

Rationale: ED independence from computing and network platform vendors allows full and open competition and supports modular system development to achieve the best return on ED IT investments.

Potential Benefits and Advantages:

1. Enables greater use of modular system development.
2. The agency will be less vulnerable to being held hostage to complex proprietary systems.
3. Competition from technology service providers will improve.
4. The agency will be more disciplined in determining its requirements and needs.
5. Components can be more easily replaced, whether because of reaching ends of useful lives, incorporating new capabilities, or failing to meet expectations.

Potential Costs and Risks:

1. Legacy systems will have to be replaced.
2. To maintain its usefulness, the ITA will have to be kept current, including specifically the Technical Reference Model which articulates the product, service and interface standards.
3. Extremely disciplined decision making will be required to assure service level needs are appropriately met, and to assure that the attractiveness of short term gains does not occur at the expense of violating ITA principles and long-term benefits.
4. Discipline will be required to assure that solutions and products are pilot tested to assess compliance with standards and principles.

Principle 10. When most cost-effective and beneficial, systems and components of systems will be implemented using commercial off-the-shelf (COTS) and Government off-the-shelf (GOTS) products.

Rationale: The use of COTS and GOTS products in a standards-based environment is potentially more cost-effective and efficient than other approaches because of reduced development, implementation, maintenance, and training costs. Buying existing commercial services may provide the best value solution for parts of work processes.

Potential Benefits and Advantages:

1. Moving from customized solutions will significantly reduce costs for development and maintenance.
2. Use of commercial services in lieu of **owned** services often yields considerable savings.
3. The use of COTS solutions offers promise of reduced development time, increased development productivity and improved system quality.
4. Marketplace competition leads to alternative sourcing for many technologies.

Potential Costs and Risks:

1. Resources will be required to support the development of solid business case analyses in selecting COTS, GOTS, or commercial services; business case analysis training will be required for IT managers.
2. Choosing COTS technologies requires caution since many vendors are new, many products may be unproven, many solutions complex, and open standards are still evolving.
3. Implementing COTS packages without adequately aligning business processes to the package can result in excessive customization costs.

WORK PRINCIPLES

Principle 11. ED will support a common network environment using a standard set of protocols to interconnect workstations, computers, and communications devices and provide such services as file transfer, electronic mail, directory management, and network management.

Rationale: Network connectivity is essential for linking Department employees with each other and with their partners and customers. The communications and information sharing capabilities provided by networks are critical for empowering staff, improving productivity, and meeting customer needs.

Potential Benefits and Advantages:

1. Communications among staff and with customers will be easier and faster.
2. Staff productivity and efficiency will improve.
3. Customer services will be more responsive to customer needs.

4. Divestiture of non-compliant devices will result in support cost savings.
5. A common network operating environment will support scalability to meet future requirements.

Potential Costs and Risks:

1. Requires integration of local- and wide-area networks with external public data networks to provide connectivity with ED partners and customers.
2. Application and system venders must support interconnectivity; products that do not meet standards cannot be considered.

Principle 12. Applications will present a consistent user interface that meets ED standards for accessibility.

Rationale: A consistent user interface can improve user productivity by supporting integrated use of applications. A consistent user interface also facilitates training staff how to use new applications. By designing a consistent user interface that is fully accessible to the disabled, all may be assured of the ability to use departmental applications.

Potential Benefits and Advantages:

1. Ease of use will improve productivity.
2. Training will be less costly and time consuming.
3. Staff will intuitively learn new applications.
4. Persons with disabilities will be able to use all applications.
5. Applications using interfaces shared by ED partners (e.g. web browsers) will be more readily accepted and widely used.
6. Promotes application portability and facilitates development of future applications.

Potential Costs and Risks:

1. Conversion of applications to a consistent user interface can be expensive.
2. Conversion of very old applications may not be easy or even possible.
3. Accessibility requirements may rule out otherwise attractive COTS products.

Principle 13. Reduce Integration Complexity. Select open standards-based products, tools, designs, applications, and methods to reduce integration and infrastructure complexity.

Rationale: To achieve open systems, standards-based products are required. The use of standard interfaces and products that adhere to open standards will help reduce the complexity associated with the IT environment.

Potential Benefits and Advantages:

1. Use of open standards-based products reduces the need to develop custom solutions to make components interoperable, thus reducing time and cost of developing and supporting new systems and upgrades.
2. Costs associated with help desk support, training and total cost of ownership can also be reduced through the reduction in the complexity of the information infrastructure.
3. Less complex structures and better integration means easier information access and sharing, encouraging use of the resources.
4. Risks associated with system implementation and upgrades will be reduced.
5. Applications will behave in a logically consistent manner across user environments.

Potential Costs and Risks:

1. Leading edge, rather than modern but proven, technology use will have to be reduced or generally avoided if it leads to overly complex environments.

Principle 14. Data processing resources (hardware, software, and data) will be shared by all users requiring the services of those resources.

Rationale: Many information technology resources, especially computing platforms and storage, can be shared efficiently. Traditional work patterns resulted in dedicated resources for applications, resulting in inefficient use of the resources.

Potential Benefits and Advantages:

1. Fewer resources will be easier to manage.
2. Maintenance and support costs will reduce over time.

Potential Costs and Risks:

1. Initial investment in properly configured and sized equipment will require up-front planning and investment.
2. The culture of wanting separated dedicated resources for each organizations “own” application will be difficult to change.

Principle 15. Data will be entered once, and only once, as close to its source as possible.

Rationale: Data collection burdens for both the Department and its customers will be reduced. Collecting data once at its source reduces multiple copies of information that characterize existing ED databases. The level of effort for managing data will be reduced.

Potential Benefits and Advantages:

1. Duplicate and inconsistent database copies will be eliminated.
2. Reliable information will result.
3. Redundancies in collection, storage, processing, and dissemination of data will be eliminated.
4. Costs will be reduced in the long term.
5. Collection burdens on the customer will be reduced.

Potential Costs and Risks:

1. Initial costs for conversion will be significant.
2. To the extent there are data dependencies, the ability to provide the capacity to process common data could involve significant development resources.
3. Once committed to this principle, it is very costly and potentially dangerous from a data integrity view to compromise midstream.

FUNCTIONAL PRINCIPLES

Principle 16. Applications will be based on object-oriented design and structure, in which objects encapsulate data structures and present a functional interface to application logic.

Rationale: Objects create a functional interface to data elements and permit developers to modify access methods and underlying data structures independent of the application.

Potential Benefits and Advantages:

1. Object-oriented design supports re-use of objects across many applications and improves flexibility.

Potential Costs and Risks:

1. Designers and developers must be trained in this methodology.
2. Object-oriented design requires high-level engineering expertise and discipline.
3. ED will need to establish design and development guidelines.

Principle 17. Applications will be event-driven, employing a real-time processing methodology versus batch processing.

Rationale: Real-time event processing supports rapid response to business events and an up-to-date data environment.

Potential Benefits and Advantages:

1. Essential to 7 days a week and 24 hours a day operations, ensuring that customers have access to current data on an as-needed basis.

Potential Costs and Risks:

1. Real-time processing increases application complexity.
2. Designers and developers will require training.
3. Guidelines must be established to ensure that applications meet real-time processing requirements.

Principle 18. New systems will be designed to be flexible enough to evolve with changing business, functional, and technology requirements.

Rationale: Periodic re-engineering of ED work processes, new programmatic demands, and the rapid pace of technological change require IT systems that can adapt to new demands.

Potential Benefits and Advantages:

1. Flexible systems based on industry-accepted open standards and modular components facilitate change to meet new requirements and accommodate technology options.
2. Modular components reduce risk by limiting scope of investment while providing functionality.

Potential Costs and Risks:

1. Flexible systems may initially be more expensive to develop and implement because of the thorough market research and testing for standards compliance that is needed.
2. Temptation to continuously re-engineer, when major work is done, can drive up system costs.
3. Management training will be required for scoping modularized procurements.

Principle 19. Applications will be portable and scalable.

Rationale: Portability and scalability of applications will assure that technological upgrade and change can be carried out with a minimum of risk and disruption to operations.

Potential Benefits and Advantages:

1. By making applications portable they can be moved from one platform to another with minimum change, thus allowing opportunities for technological change and upgrade.
2. By making applications scalable they can be adjusted for size without incurring additional costs of redevelopment, thus supporting responses to program and requirements growth.

Potential Costs and Risks:

1. Many existing applications are neither portable or scalable. Changing the existing applications to meet this principle will require significant initial investment.
2. As the need for portability and scalability depends on future activities or changed condition, it may be difficult for program managers to understand the need for applying this principle.

Principle 20. Information systems will be designed and implemented using standards-compliant system components.

Rationale: Use of standards-based components supports incremental acquisition of systems, as required by the Clinger-Cohen Act. It assures that new and redesigned systems will be open, that is they will be upgradable because old components can be replaced with new improved components that use the same standard interfaces, thus assuring continuing functionality.

Potential Benefits and Advantages:

1. Standards-based components, using supported standards-compliant products, will keep product support costs manageable.
2. Significant time will be saved when selecting products for system design and implementation.

Potential Costs and Risks:

1. Initial costs to convert to standards-compliant products will be incurred.
2. Exceptions, although based on business case justification, will increase product support costs.

Principle 21. ED will implement cross-functional systems that take advantage of common software modules that may be shared and reused for similar business functions.

Rationale: Many ED offices share common work processes with similar information requirements (e.g. announcing competitions, processing applications, making grant awards) and may be able to reuse applications, data, and related information technology across the Department. Common software modules may be reused for similar functions.

Potential Benefits and Advantages:

1. OCIO will support a library of shared common software modules accessible to business and IT managers.
2. Systems based on standard software modules can be implemented faster and with better quality than systems based on newly designed components.
3. An enterprise-wide, cross-functional review will identify similar functions, thus eliminating duplicative design and development activities.
4. Office work processes will need to be re-engineered to support common functions and common software module usage; efficiencies may be expected as a result.

Potential Costs and Risks:

1. Transition to cross-functional systems will take extra resources for planning, coordinated requirements analyses, and work process re-engineering.
2. "Owners" of systems may resist changing to stewardship roles.
3. Nothing is resisted as much as changing office work processes; considerable effort will be required to get buy-in from the staff.

Principle 22. Applications and information technology assets that are common to multiple mission areas will be centrally developed or acquired.

Rationale: Because many ED offices share common work practices with similar information requirements, central acquisition or development of applications and information technology assets that are common to multiple mission areas will provide the Department economies of scale advantages and will reduce the risk of redundancy and unnecessary support resources.

Potential Benefits and Advantages:

1. Central management of development or acquisition of applications and information assets will provide the Department with economies of scale efficiencies.
2. Central management will ease the cost burden for license management, support services, and maintenance of applications.

3. Centrally managed development

Potential Costs and Risks:
1. Because acquisition and development of applications and information technology assets has traditionally been decentralized, resistance to giving up local control can be expected.
2. Principal offices, and functional units within those offices, may perceive requirement uniqueness when in fact commonality exists. These perceptions may lead to resistance to central acquisition and development.

Principle 23. Standardized information system tools will be used for systems design, development, and configuration management.

Rationale: Standardized system analysis, design, and development tools will help IT managers create a consistent and repeatable systems development life cycle, resulting in a predictable and efficient process that will improve over time.

Potential Benefits and Advantages:

1. Standard computer assisted software engineering (CASE) tools will support enterprise information repositories, including data definitions, work process definitions, functional modules, and component development.
2. Department ownership, control, and management of the primary repository will assure compliance with the standards by contractors.
3. An eventual standardized development environment will result in long-term cost savings and elimination of redundancies in data management and systems design.
4. Standard tools will ensure continuity in the systems development life cycle across contractor transitions.

Potential Costs and Risks:

1. Contractors will be required to use the standard ED tools rather than their own preferred tools; this may reduce competition for development work.
2. Initial costs for CASE tools may be significant.
3. Conversion from existing CASE tools to the enterprise standard will require extra staff or contractor resources.

INFORMATION PRINCIPLES

Principle 24. Security policies and practices will be consistently implemented across ED systems.

Rationale: ED applications and data must be readily available and accessible to authorized users without compromising the security, integrity, and confidentiality of those systems and data—particularly for data on individuals and financial information.

Potential Benefits and Advantages:

1. Enterprise-wide policies and standards for security will apply.
2. Security policies and standards will be reviewed in terms of the ITA, published, promulgated, and kept current.
3. Staff will be aware of and practice security and privacy policies.
4. Security policy practices will be systematically assessed and policies and standards enforced.
5. Local security officers will be fully aware of applicable enterprise wide security policies and standards.
6. Security policies and standards will be enforced locally.
7. Security of equipment, data and intellectual property will be improved.
8. Expenses associated with equipment loss and theft will be reduced.

Potential Costs and Risks:

1. Setup of the enterprise-wide security infrastructure will incur initial costs in time and support services.
2. Initial and maintenance training will be required for local security officials.
3. Security is not always taken seriously; reeducation will be required to overcome resistance.

Principle 25. Data is a Department asset and does not belong to any particular office, program, or individual.

Rationale: Data is a strategic asset to be shared and easily accessed across the Department—and with customers and partners—to support better customer service and management decision making. This requires a shift in ED culture regarding data from "ownership" to "stewardship," which includes responsibility for the accuracy, timeliness, and integrity of data without any proprietary restriction on its use. Enterprise-wide standards governing the availability, accessibility, and security of ED data will be the responsibility of the Department data oversight body.

Potential Benefits and Advantages:

1. Data management owners will follow an established change management process and will notify all affected parties when changes are made to the data.
2. The needs of the Department as a whole will be considered in every collection, creation, storage, processing, and dissemination activity.
3. Data and thus information will be reliable.

4. Customers will receive faster and better quality service.

Potential Costs and Risks:

1. The data management process will need to be thoroughly revamped and a new data management structure implemented; time and resources will be required.

Principle 26. ED data will conform to a standardized set of data elements and definitions.

Rationale: Effective information sharing and exchange depends on a shared definition of standard data elements throughout the Department. To support program decision making, the timeliness and integrity of each data element should meet the information needs of the most demanding Department user.

Potential Benefits and Advantages:

1. ED data definitions should be consistent with definitions used by the Department's suppliers of information, the customers who use that information, and all applicable standards (e.g. Federal, national, international).
2. Definitions included in laws and regulations will be clearly stated and, if possible, will reflect the most useful common definition.
3. Collaboration among program and appropriate staff offices will result in clearly defined information and data needs.
4. Redundant data collection, storage, processing, and dissemination will be eliminated.
5. Information will be more easily exchanged and shared with customers and constituents using data standards.

Potential Costs and Risks:

1. Validating, normalizing and standardizing data is a very large, costly undertaking.
2. Reaching agreement on definitions may be time consuming.
3. Revamping the data elements in legacy systems will take considerable time and effort.

NEXT STEPS

The standards-based architecture planning process, as defined by the TAFIM, has seven distinct, but interdependent, phases. Each phase of the process has separate products, or documents, that guide the subsequent phase. The seven phases are described below.

Phase 1. Initiation and Architecture Framework. This document is the product of the first phase of the ITA planning process. The steps undertaken in the ITA Framework phase began with an identification of the agency's business drivers. These were specifically derived from the Department of Education Strategic Plan and its subsequent Annual Plan. The architecture principles were developed in response to the business drivers extracted from the Strategic Plan. The architecture principles are high level policy statements, with specific implications, that will drive subsequent practices and actions for agency migration to its new technical environment. The benefits and costs of applying these principles are outlined to illustrate that the transformation to a standards-based IT architecture is not a simple or risk-free endeavor.

Phase 2. Baseline Characterization. The second phase, the next to be undertaken, will assess and characterize the current ED IT environment as the baseline for development of a target architecture. The baseline will be characterized along four dimensions or views: work, information, application, and technology. The term characterization is used because the data gathering and analysis are not exhaustive. It is neither necessary nor desirable to expend the time and effort to document every detail of the current architecture. A set of templates reflecting the four views of the current architecture will subsequently be used to help define a target architecture and analyze the gap between the baseline and target architectures.

Phase 4. Target Architecture. The heart of the ITA development process is the modeling of the work, information, application, and technology views in terms of a desirable target architecture, from three to five years in the future. Architectural components and their attributes are defined, and the components are then used to define desired relationships using affinity analyses. The result is an organized set of definitions and modes from which drawings can be made to reflect the different views of the architecture. During this phase, standards and guidelines to be used by the organization in acquiring technology and developing applications occurs. The standards and guidelines can relate to any or all of the components in the target architecture models. Areas where standards are needed most urgently can be targeted for quick resolution and others assigned for later investigation.

Phase 4. Opportunity Identification. This phase moves the architecture out of the conceptual world into one where practical realities govern implementation. In this

phase, short-term opportunities are identified which, once implemented, can demonstrate the value of the architecture and provide immediate benefits to the organization. In addition, all projects that are necessary to achieve the target architecture are identified and fleshed out in some detail.

Phase 5. Migration Options. Phase five links the reality of the present with the desirability of the target architecture by establishing one or more plateaus representing practical migration stages. The same type of models, using the common framework, can be used to represent these evolutionary plans. All projects identified in the previous step are prioritized over time based on inter-project dependencies and cost/benefit analyses.

Phase 6. Implementation Planning. This phase results in a detailed implementation plan for the first plateau of the migration effort. It constitutes the first wave of actionable projects that establish the groundwork for each successive plateau of the target architecture implementation. Plateau 1 projects are generally linked to the next stage in the migration plan. Responsibilities are established to ensure that they are carried out and that the migration plan is properly updated.

Phase 7. Institutionalizing the ITA Process. The administration of a standards-base IT architecture process is required to keep the ITA alive and well by continuously improving it. The ongoing administration of the ITA process ensures architecture adjustment decisions in accordance with unforeseen changes in business directions or advances in technology or its availability. The institutionalization of the ITA process allows adjustments to be made based on experience and ensures that modifications in standards and supporting processes reflect a realistic approach. It allows reentry into the ITA process at any point, depending on the area to be adjusted or updated.